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Sense of coherence does not moderate the relationship between the perceived impact of stress on health and self-rated health in adults with congenital heart disease

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ABSTRACT

Background: Adults with congenital heart disease seem to be more distressed than their healthy counterparts, which might render them even more susceptible to developing detrimental health outcomes. Previous research has confirmed the relationship between the perceived impact of stress on health and self-rated health. However, it remains unknown whether sense of coherence, a person's capacity to cope with stressors, moderates this relationship.

Aim: This cross-sectional study aims to explore: the relationship between demographic and clinical characteristics, sense of coherence, and the perceived impact of stress on health; the relationship between the perceived impact of stress on health and self-rated health; and the moderating effect of sense of coherence in a sample of adults with congenital heart disease.

Methods: Patients were recruited from the database of congenital and structural cardiology of a university hospital. The analytic sample included 255 patients (median age 35 years; 50% men). Data were obtained using self-report questionnaires and through medical record view. Univariate analyses and multiple regression analysis were conducted.

Results: The perceived impact of stress on health was negatively associated with sense of coherence ($p<0.01$), but there was no significant association with demographic or clinical characteristics. The perceived impact of stress on health and self-rated health were negatively associated ($p<0.001$), but sense of coherence did not moderate this relationship.

Conclusions: Our findings support the need for further research on the perceived impact of stress on health. Such insights can be valuable for developing interventions aimed at reducing the negative health consequences of stress in patients with congenital heart disease.

Keywords: Adult; Chronic Disease; Heart Defects, Congenital; Sense of Coherence; Stress, Psychological; Self-Rated Health

INTRODUCTION

Stress is a common phenomenon in western society. Nearly everyone experiences stress at some point in their life. Lazarus (1966: 9), being a pioneer in research on stress and emotions, defined stress as follows: 'stress occurs when an individual perceives that the demands of an external situation are beyond his or her perceived ability to cope with them'.[1] Stress can be particularly prevalent in individuals with chronic conditions. Indeed, the specific demands posed by having a chronic condition can be an important source of stress to patients.[2]

Congenital heart disease (CHD) is such a chronic condition. CHD is the most common birth defect, occurring in 9.3 per 1000 live births.[3] Because of the ever-improving survival rates due to advances in cardiac surgery and paediatric cardiology, the group of patients with CHD is growing.[4,5] The prevalence of CHD in the population is estimated to be 5780 per million inhabitants.[5] To date, almost 90% of children with CHD have the prospect of surviving into adulthood.[4] Irrespective of this increased life expectancy, these patients are at risk of long-term adverse health outcomes, including infections of respiratory tract, throat, lungs and sinuses, heart infection, endocarditis, pulmonary hypertension, high blood pressure, and the heart being unstable to pump enough blood, which can cause heart failure.[6] Furthermore, patients with CHD seem to be more distressed than their healthy counterparts.[7] Examples of potential stressors for patients with CHD include feelings of being different, a lack or an overload of information about their heart disease,[8] loneliness, fear of negative evaluation, imposed limits, low exercise capacity and poor self-rated health.[9] Prolonged exposure to stress has a clear impact on health and has been associated with both psychological and physical adverse outcomes, such as depression, diabetes, obesity, hypertension, myocardial infarction, tachyarrhythmia and stress cardiomyopathy.[10-15] Therefore, experiencing stress can render individuals with CHD even more susceptible to developing detrimental health outcomes.

A new concept has emerged that could provide a deeper insight into the possible effects of stress, namely the perceived impact of stress on health.[16,17] This perceived impact of stress on health measures to what extent people feel that the stress or pressure they have experienced in their life has affected their health. This concept differs conceptually from the amount of stress an individual experiences, as one could experience very little stress (i.e. the amount of stress), but still believe it has a great impact on his or her health (i.e. the perceived impact of stress). It also differs conceptually from self-rated health, as self-rated health is a measure of how people describe their own health. This study will focus on the perceived impact of stress on health. It has been hypothesised that individuals who believe stress to have a negative impact on their health can actually have poorer health. Therefore, two recently published prospective cohort studies have investigated the perceived impact of stress on health.[16,17] These studies have shown that the perceived impact of stress on health is indeed associated with poor self-rated health, psychological distress and an increased risk of fatal and non-fatal coronary heart disease.[16,17]

Another important concept in relation to stress is sense of coherence (SOC).[18] The theory of SOC provides a possible explanation as to why some people become ill when stressed, whereas others remain healthy. SOC represents an individual's generalised world view and is determined by the extent to which one perceives his or her internal and external environments as comprehensible, manageable and meaningful.[18] Individuals with a strong SOC are confident that resources are available to cope with the demands of a stressful situation and, thus, consider a stressor to be more of a challenge than a threat.[18,19] Consequently, a strong SOC has a positive influence on an individual's health.[18,20] Indeed, previous studies exploring SOC in patients with CHD found a relationship between SOC and patient-reported outcomes (PROs). A strong SOC predicted better self-rated health in adolescents with CHD.[21] Furthermore, SOC and self-rated health explained the better quality

of life in this population.[22] Importantly, a better quality of life and self-rated health, in turn, could improve clinical outcomes, such as morbidity and mortality.[23]

In sum, previous studies have confirmed the relationship between the perceived impact of stress on health and self-rated health,[16] and between SOC and self-rated health.[21] Based on theoretical and empirical grounds, we hypothesise that SOC and the perceived impact of stress are associated and that, therefore, SOC might have a moderating effect on the relationship between the perceived impact of stress on health and self-rated health. SOC might specify the conditions under which the perceived impact of stress on health is associated with self-rated health. It is possible that people believe stress to have a great impact on their health and, consequently, have a poorer self-rated health, depending on their level of SOC (i.e. their capacity to cope with stressors). In other words, those with the perception that stress affects their health and the lowest SOC will have the worst self-rated health. As such, this study aims to explore: the relationship between demographic and clinical characteristics and the perceived impact of stress on health, and between SOC and the perceived impact of stress on health; the relationship between the perceived impact of stress on health and self-rated health; and the moderating effect of SOC on this latter relationship in a sample of adults with CHD.

METHODS

Study population and procedure

This cross-sectional study is based on the setting and sample criteria of a longitudinal three-wave study on PROs in adults with CHD. Patients were randomly recruited from the database of congenital and structural cardiology of the University Hospitals Leuven, Belgium. Patients were eligible to participate if they met the following criteria: literate, Dutch-speaking; diagnosis of CHD (defined as a gross structural abnormality of the heart or intra-thoracic

great vessels that is actually or potentially of functional significance including simple, moderate and complex heart defects);[24] aged 18 years or older; diagnosed under the age of 10 years, that is, before adolescence; in follow up at our tertiary care centre; and showing sufficient physical, cognitive and language abilities to complete self-report questionnaires. Exclusion criteria were: prior heart transplantation; isolated pulmonary hypertension; and syndromes affecting cognitive abilities. For the first measurement wave of the longitudinal study, 400 patients were randomly selected from the hospital's database. For the current study, data from the second measurement wave were used as the perceived impact of stress on health was measured at this time point. Overall, 344 patients were eligible to participate.

Eligible patients received a study package by mail including a study information letter, a copy of the survey package, an informed consent form and an addressed prestamped envelope. Patients were asked to complete and return the questionnaires and informed consent form within 2 weeks. Filling out the questionnaires lasted approximately 60 minutes. To increase the response rate, a voucher for a weekend out was raffled at the end of the study and a modified Dillman's approach was used.[25] This approach consisted of sending two written reminders and a telephone reminder for non-responders. Data collection ran from September 2014 to March 2015. Study participation was voluntary, a coded dataset was used and informed consent was obtained. The study was approved by the institutional review board of the University Hospitals Leuven and the investigation was conducted in keeping with the principles outlined in the Declaration of Helsinki.

Variables and measurement

Demographic information (i.e. age, sex and educational level) was collected using a self-report form. Information about disease complexity was obtained through medical record review. The three PROs of interest (i.e. the perceived impact of stress on health, SOC and self-rated health) were assessed by means of self-report questionnaires.

Perceived impact of stress on health. The perceived impact of stress on health was measured using a question from the Whitehall II prospective study.[17] Respondents were asked 'To what extent do you feel that the stress or pressure you have experienced in your life has affected your health?' Response choices were: (1) 'not at all'; (2) 'slightly'; (3) 'moderately'; (4) 'a lot'; or (5) 'extremely'.[17] The psychometric properties of this instrument remain to be investigated.

Sense of coherence. The 13-item version of the orientation to life questionnaire developed by Antonovsky was used.[18] This questionnaire consists of four meaningfulness items, five comprehensibility items and four manageability items. All items were answered on a seven-point Likert scale, with options ranging from 1 (very seldom or never) to 7 (very often). Five items were reverse scored so that high total scores represented high levels of SOC. Validity and reliability of this instrument are well established.[26]

Self-rated health. Self-rated health was measured using the visual analogue scale (EQ-VAS) from the EuroQoL-5D.[27] This vertical 20 cm visual analogue scale enables respondents to place their current health status on a scale from 0 (worst imaginable health state) to 100 (best imaginable health state). This is a valid and reliable instrument to use in cardiovascular populations.[27]

Statistical analyses

Demographic and clinical patient characteristics are presented as frequencies and percentages or as median values with their interquartile ranges (IQR). First, simple linear regression analysis and one-way analyses of variance (ANOVAs) were used to estimate the effect of SOC on the perceived impact of stress on health. In addition, the relationship between SOC and the perceived impact of stress on health was tested by calculating a Pearson's correlation coefficient. Second, a simple linear regression analysis was employed to evaluate the relationship between the perceived impact of stress on health and self-rated health, controlling

for potential demographic or clinical confounders from the first analyses. Third, a multiple linear regression model was used to identify the moderating effect of SOC on the relationship between the perceived impact of stress on health and self-rated health, controlling for potential confounders (i.e. sex, age, educational level and disease complexity) from the first analyses. Only patients with complete data on all these variables were included in the analytical sample. All predictors were entered into the model simultaneously. To reduce the possibility of multicollinearity, the independent variables were centred on the mean.[28] All tests were two-tailed and a p-value ≤ 0.05 was considered to be statistically significant. Assumptions of linear regression (i.e. linear relationship, multivariate normality, no or little multicollinearity, no auto-correlation and homoscedasticity) and ANOVA (i.e. multivariate normality and homoscedasticity) were tested[28] and there were no violations. Data were analysed using SPSS version 20.0 (SPSS Inc., Chicago, Illinois, USA).

RESULTS

Sample characteristics

A total of 255 adults with CHD participated (response rate 74.1%), including 127 men (50.2%). The median age in this sample was 35 years (IQR 15) and 125 patients (49.4%) had obtained a college or university degree. The majority of patients had a moderately complex heart defect (55.3%). Additional demographic and clinical characteristics are presented in Table 1.[29]

Scores on PROs

In total, 252 patients (98.8%) answered the question on the perceived impact of stress on health. Most of the patients (38.1%) felt that the stress or pressure they have experienced slightly affected their health, whereas 26.2% of patients felt that stress had no effect on their

health. Furthermore, 23.0% and 11.1% of patients believed that stress affected their health moderately and a lot, respectively. Only 1.6% of patients had the perception that stress affected their health extremely. The median score of 252 patients (98.8%) on self-rated health was 80 (IQR 20) on a scale from 0 to 100, representing a good self-rated health. Furthermore, 251 patients (98.4%) rated their SOC on a scale from 13 to 91. The median total SOC score in this sample of adults with CHD was 64.0 (IQR 19).

Relationships between demographic and clinical characteristics, SOC and the perceived impact of stress on health

First, simple regression analysis showed that there was no significant relationship between age and the perceived impact of stress on health (Table 2). Furthermore, ANOVAs showed that sex, educational level and disease complexity were not significantly associated with the perceived impact of stress on health (Table 2). Therefore, none of these variables were included in further analyses. In addition, simple regression analysis showed that there was a significant relationship between age and self-rated health status ($F=16.424$, $p<0.001$). ANOVA showed that educational level was significantly associated with self-rated health ($F=10.325$, $p<0.001$), but no relationship was found between sex, disease complexity and self-rated health (Table 3).

Second, SOC was negatively and significantly correlated with the perceived impact of stress on health (Pearson's $r=-0.51$, $p<0.01$). Full data on these two variables were available for 250 patients. Simple linear regression analysis showed that SOC and perceived impact of stress on health were significantly associated. The stronger patients' SOC, the less patients believed that stress affected their health ($B=-0.05$, $t=-10.67$, $p<0.001$). Overall, SOC explained 31.0% (adjusted $R^2=0.31$) of the variation in the perceived impact of stress on health.

The relationship between the perceived impact of stress on health and self-rated health

Full data were available for 250 patients. Simple linear regression analysis showed that the perception that stress affects health and self-rated health were significantly associated. The more patients believed that stress affected their health, the poorer their self-rated health was ($B=-7.54$, $t=-9.41$, $p<0.001$). Overall, the perceived impact of stress on health explained 26.0% (adjusted $R^2=0.26$) of the variation in self-rated health.

The moderating effect of SOC

Table 4 shows the effect of SOC as a moderating variable on the relationship between the perceived impact of stress on health and self-rated health. Full data on all these variables were available for 247 patients. Multiple linear regression showed that SOC did not moderate the relationship between the perception that stress affects health and patients' self-rated health ($p=0.578$) (Table 4).

DISCUSSION

This study aimed to uncover the relationships between three PROs in a sample of adults with CHD. More specifically, we looked at the relationship between the perceived impact of stress on health and self-rated health, and the potential moderating role of SOC on this relationship. In sum, our results showed that patients' age, sex, educational level, or disease complexity were not significantly associated with the perceived impact of stress on health. In line with previous research,[16] a significant relationship between the perceived impact of stress on health and self-rated health was found in this sample of adults with CHD. More specifically, the more patients believed that stress affected their health, the poorer their self-rated health was. This result could be of significant importance, as poor self-rated health is associated with clinical outcomes such as morbidity and mortality in cardiac populations.[23] Although SOC

and the perceived impact of stress on health were significantly associated, SOC did not moderate the relationship between perceived impact of stress on health and self-rated health.

To date, empirical evidence on the perceived impact of stress on health is scarce. We are aware of only two previous studies examining this PRO. The group of Keller et al.[16] explored the effect of the perception that stress affects health on self-rated health, psychological distress and mortality in a nationally representative sample of US adults. Nabi et al.[17] explored the relation between the perceived impact of stress on health and the prevalence of fatal and non-fatal coronary heart disease in civil servants aged 35-55 years from 20 London-based departments, controlling for several covariates including self-rated health. The results of the present study were consistent with the results of Keller et al.,[16] showing that individuals who perceived that stress affected their health were more likely to report poor self-rated health. Furthermore, the majority of patients (53.0%) in the study of Nabi et al.[17] felt that the stress or pressure they had experienced slightly or moderately affected their health, similar to 61.1% of patients in the present study. Most participants (66.3%) in the study of Keller et al.[16] had hardly any or no perception that stress affected their health, whereas 26.2% of patients in the present study felt that stress had hardly any effect on their health at all. A possible explanation for this difference in results could be the difference in study populations. More specifically, patients with CHD might experience more health problems than the general population in the study of Keller et al.[16]

The median total SOC score in this sample of adults with CHD was comparable to the total SOC scores in samples of patients with coronary heart disease[30] and adolescents with CHD.[22] In the latter group, patients' SOC proved to be significantly higher than the SOC of controls.[22] In addition, a study by Berghammer et al. found similar scores on the EQ-VAS in adults with CHD.[31] These comparable results show that the sample of this study does not consist of an exceptional group of patients.

This is the first study examining the moderating role of SOC on the relationship between the perceived impact of stress on health and self-rated health. Previous research on SOC and self-rated health has already demonstrated the importance of these concepts in cardiovascular populations and, more specifically, in patients with CHD.[22,32,33] As stated before, patients with CHD do experience specific psychosocial stressors. The capacity to cope with those stressors depends on the strength of their SOC. Patients who believe they do not possess sufficient resources to cope with a stressor feel threatened.[34] It is possible that patients who believe that stress affects their health consider a stressor to be more of a threat than a challenge and do not have the capacity to respond to that threat. Physiologically, threat is characterised by an activation of the sympathetic-adrenal-medullary axis and is associated with reduced cardiac efficiency and vasoconstriction.[35] The perceived impact of stress on health and SOC could therefore be responsible for individual differences in responses to stress and in stress-related outcomes. Nonetheless, SOC did not moderate this relationship in our study. It might be possible that there are other moderating variables. Resilience, for example, could be of significant importance in moderating this relationship. Resilience is the process of adapting well to stressful life events such as health problems, and is therefore an important resource for coping with stress.[36] Previous research revealed that individuals who have experienced a moderate amount of adversity in the past exhibit more resilience to recent adversity,[37] suggesting that previous experiences with stress may help individuals to cope with current stress.

Strengths and limitations

This study has several strengths. First, research on individuals' perceived impact of stress on health is scarce, whereas studies examining the amount of stress a person experiences are common.[38] Previous research concluded that the perceived impact of stress on health predicted the incidence of coronary heart disease independently of the amount of stress a

person experiences.[17] This result suggests that the perceived impact of stress on health is an important concept in addition to the amount of stress. Second, the present study was conducted in a large sample of adults with CHD. By using a modified Dillman's approach[25] and raffling a voucher for a weekend out, a high response rate was obtained. Third, both validity and reliability of the instruments measuring SOC and self-rated health are well established.[26,27] Fourth, the relationship as found in this study was independent of a range of confounders.

It is important to note some limitations. First, self-report questionnaires were sent by postal mail to the patient's home address. Therefore, in-depth information on the clinical condition of the patients at the time of filling out the questionnaires was lacking. Second, patients were recruited from the database of one university hospital. Furthermore, the results of this study only apply to adult patients who have normal cognitive functions. Both of these factors might limit the generalisability of our findings. Third, the perceived impact of stress on health was measured using a single item, which might have introduced observation bias. Moreover, it is not possible to calculate reliability of a single item. In addition, the psychometric properties of this instrument remain to be investigated as this is only the second study using this single item measure. Fourth, although the associations found in this study were independent of a range of potential confounders, there could be residual confounding. Fifth, the cross-sectional design of this study does not allow conclusions to be drawn in terms of the direction of associations.[28]

Recommendations

Adults with CHD constitute a growing patient population.[5] To meet the specific needs of this emerging population, understanding the role of PROs is critical for developing comprehensive healthcare programs. The results of this study, in combination with the results of two previous studies,[16,17] suggest that the perceived impact of stress on health can be of significant

importance to predict health outcomes and, hence, that changing a person's attitude towards stress has the potential to improve their health. Healthcare workers can play a major role in encouraging patients to perceive stress as a signal which prepares their body for a future challenge instead of perceiving stress as a dangerous enemy.[15] Such a mindset could have far-reaching implications for future research and for designing interventions aimed at reducing the negative health consequences of stress. Indeed, new insights can be used to improve healthcare for patients with CHD. For example, tailored stress-reducing interventions can be integrated into healthcare in order to improve patients' psychosocial functioning.

Unexpectedly, SOC did not moderate the relationship between the perceived impact of stress on health and self-rated health, although SOC was significantly associated with the perceived impact of stress on health. Replication studies are needed to confirm or refute these findings. Furthermore, other explanatory factors should be taken into account in future research.

In conclusion, our findings support the need for future research on the perceived impact of stress on health as it proved to be a valuable PRO in adults with CHD.

IMPLICATIONS FOR PRACTICE

- The new concept of perceived impact of stress on health can be of significant importance to predict health outcomes in patients with CHD and, hence, changing a patient's attitude towards stress has the potential to improve health.
- Healthcare workers can play a major role in encouraging patients to perceive stress as a signal that prepares their body for a future challenge instead of perceiving stress as a dangerous enemy.
- Tailored stress-reducing interventions can be integrated into healthcare for patients with CHD in order to improve their psychosocial functioning.

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CONFLICT OF INTEREST

None declared.

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Table 1. Demographic and clinical characteristics of adults with congenital heart disease (n=255).

Characteristics	n (%)
Men (n=253)	127 (50.2)
Median age in years (n=253)	35 (IQR 15.0)
Marital status (n=252)	
Unmarried/never married	59 (23.4)
Married/remarried	118 (46.8)
Separated/divorced	14 (5.6)
Living with a partner	60 (23.8)
Widowed	1 (0.4)
Educational level (n=253)	
Secondary school or less	128 (50.6)
College/university degree	125 (49.4)
Employment status (n=255)	
Full-time paid work	149 (58.4)
Part-time paid work	53 (20.8)
Homemaker	6 (2.4)
Job seeking	2 (0.8)
Unemployed	3 (1.2)
Disability/government financial assistance	28 (11)
Retired	10 (3.9)
Other	4 (1.6)
Disease complexity (n=255)[a]	
Simple	83 (32.5)
Isolated aortic valve disease (including BAV without significant haemodynamic lesions)	18 (7.3)
Small ASD or VSD	24 (9.4)
Small PDA	1 (0.4)
Repaired ductus arteriosus/ASD/VSD	31 (12.2)
Other	9 (3.5)
Moderate	141 (55.3)
Anomalous pulmonary venous drainage and/or sinus venous ASD	6 (2.4)
Atrioventricular septal defects or ostium primum ASD	8 (3.1)
Coarctation of the aorta	35 (13.7)
Ebstein anomaly	4 (1.6)
Pulmonary valve disease (with stenosis or regurgitation)	14 (5.5)
Subvalvar or supravalvar aortic stenosis	19 (7.5)
Repaired tetralogy of Fallot	49 (19.2)
VSD with other complications	2 (0.8)
Marfan syndrome	3 (1.2)
Other	1 (0.4)
Complex	31 (12.2)

Double-outlet ventricle	2 (0.8)
Univentricular anatomy (Fontan circulation)	3 (1.2)
Pulmonary atresia (all forms)	1 (0.4)
Repaired TGA (atrial or arterial switch procedure)	14 (5.5)
CCTGA	8 (3.1)
Tricuspid atresia	2 (0.8)
Truncus arteriosus	1 (0.4)
Underwent cardiac surgery/intervention (n=254)	49 (19.3)
Frequency of follow-up (n=237)	
More than twice a year	6 (2.5)
Twice a year	23 (9.7)
Once a year	152 (64.1)
Every 2 years	13 (5.5)
Every 3 years	17 (7.2)
Every 4 years	10 (4.2)
Every 5 years	14 (5.9)
Less often than every 5 years	2 (0.8)
At least one or more cardiac admission (median of total number since age 18) (IQR) (n=117)	2 (2.5)

[a] In Warnes et al.[29]

BAV: bicuspid aortic valve; ASD: atrial septal defect; VSD: ventricular septal defect; PDA: patent ductus arteriosus; TGA: transposition of the great arteries; CCTGA: congenitally corrected transposition of the great arteries; IQR: interquartile range.

Table 2. Simple linear regression analysis and one-way analyses of variance examining the relationship between demographic and clinical characteristics and the perceived impact of stress on health in adults with congenital heart disease.

Predictor	n (%)	F	p-value
Age	250 (98.0)	2.161	0.143[a]
Sex	250 (98.0)	1.406	0.237[b]
Educational level	250 (98.0)	2.845	0.093[b]
Disease complexity	252 (98.8)	2.353	0.097[b]

Dependent variable: perceived impact of stress on health.
[a]p-value was calculated using simple linear regression.
[b]p-value was calculated using one-way analyses of variance.

Table 3. Simple linear regression analysis and one-way analyses of variance examining the relationship between demographic and clinical characteristics and self-rated health in adults with congenital heart disease.

Predictor	n (%)	F	p-value
Age	250 (98.0)	16.424	0.001[a]
Sex	251 (98.4)	0.001	0.996[b]
Educational level	250 (98.0)	10.325	0.001[b]
Disease complexity	252 (98.8)	0.550	0.578[b]

Dependent variable: self-rated health.
[a]p-value was calculated using simple linear regression.
[b]p-value was calculated using one-way analyses of variance.

Table 4. Multiple linear regression analysis examining the moderating effect of sense of coherence on the relationship between perceived impact of stress on health and self-rated health (n=247).

Predictor	B	SE	β	T	p-value
Constant	76.835	0.932	-	82.423	0.001
Sense of coherence	0.179	0.080	0.147	2.246	0.026
Perceived impact of stress on health	-6.496	0.988	-0.442	-6.575	0.001
Sense of coherence x perceived impact of stress on health	-0.038	0.067	-0.032	-0.557	0.578

Dependent variable: self-rated health.
SE: standard error.
Adjusted R^2=0.27.
F=31.493, $p<0.001$.